INTERNATIONAL SCIENCE AND ENGINEERING FAIR:

THE HISTORY AND NATURE OF SCIENCE

High School Activities

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The International Science and Engineering Fair:
The History and Nature of Science

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THE HISTORY AND NATURE OF SCIENCE: BEFORE THE FAIR

Activity 1: A Historical Perspective on Science
Teacher Notes

The purpose of the lesson is to acquaint students with the development of science and technology throughout time.

Time for lesson: varies: 1 class period of introduction with research completed outside class and 1-2 class periods for timeline construction or may be expanded to include research during class

Materials
Research tools (computers with internet access, text resources, library access, science magazines and journals)
Adding machine tape or long strips of paper*
Markers or colored pencils
Measuring device (ruler/meter stick)
Optional – graphics from computer or magazine pictures for illustrating timeline

*instructions involve making a timeline physically – this activity could also be done electronically using Powerpoint or *TimeLiner 5.0* (Tom Snyder Productions)

Procedure

- Brainstorm with students ideas about breakthroughs or inventions that may occur by the year 2050.
- Create a class hierarchy of scientific advancements that the students believe have most influenced their lives. Post in the classroom
- Assign students to smaller groups to research scientific progress from a given year to present time (i.e. 1600's to present).
- Allow student groups to choose an area to focus on such as medicine, transportation, communication, space, agriculture, scientific/mathematical theoretical development, cell biology, genetics, biochemistry, energy sources, computers, mechanical engineering/architecture, etc.
- Have students research the focus area for their timeline development.
- Allow students to develop the timeline according to their choice of product (i.e. adding machine tape, powerpoint, model using other materials, video, role play, etc.)
- After product completion, showcase the products.

- Revisit the hierarchy created in step 2. Lead the class in discussion or ask students to write reflectively around the following questions:
  - What changes would you now make in the order of importance/inclusion/exclusion of scientific advancements you listed at the beginning of the activity?
  - From each research focus area, what do you think would be a likely future development that will impact you as a senior citizen?
  - How will your future grandchildren's lives be even different than your lives in 2050 because of scientific developments?
  - What are some of the scientific discoveries that were dependent on prior technological developments?
  - What are some of the scientific discoveries and technological developments that seem inseparable?
  - What are some of the scientific discoveries and technological developments that are independent?

THE HISTORY AND NATURE OF SCIENCE

Activity 2: Components of a Well Designed Experiment
Teacher Notes

The purpose of the lesson is to reinforce student understanding and recognition of the components of a well-designed experiment.

Time for lesson: minimum of two class periods

Materials dependent upon activities chosen from resource list; see Appendix for additional teacher resources

Procedure

- Assess student understanding of the scientific method. Visit the Intel ISEF web site for a brief review. (www.sciserv.org)
- Included below is a list of possible resources to allow more extensive study of individual components of experimental design.
  - Identify appropriate experimental questions (purpose)
    Cothron, J.H., Giese, R.N., & Rezba, R.J. (2000). *Students and Research,* (3rd Ed.) Dubuque, IA: Kendall/Hunt Publishing Co., pp. 3-36.
    Cothron, J. H., Giese, R.N., & Rezba, R.J. (1996). *Science Experiments by the Hundreds,* Dubuque, IA: Kendall/Hunt Publishing Co., pp. 43-54.

Harlan, W. & Exploratorium Institute for Inquiry (1998). *Ice Balloons: Exploring the Role of Questioning in Inquiry.* www.exploratorium.edu/IFI/activities/index.html

- Writing a good hypothesis
  Cothron, J.H., Giese, R.N., & Rezba, R.J. (2000) *Students and Research,* (3rd Ed.) Dubuque, IA: Kendall/Hunt Publishing Co., pp. 3-36.
  Rezba, R.J., Sprague, C., Fiel, R.L., & Funk, H.J., (1995) *Learning and Assessing Science Process Skills,* (3rd Ed.) Dubuque, IA: Kendall/Hunt Publishing Co., pp. 89-108, 219-230.
- Identifying variables, a control, and constants
  Cothron, J.H., Giese, R.N., & Rezba, R.J. (2000) *Students and Research,* (3rd Ed.) Dubuque, IA: Kendall/Hunt Publishing Co., pp. 3-36.
  Cothron, J. H., Giese, R.N., & Rezba, R.J. (1996). *Science Experiments by the Hundreds,* Dubuque, IA: Kendall/Hunt Publishing Co., pp. 1-24.
  Rezba, R.J., Sprague, C., Fiel, R.L., & Funk, H.J., (1995) *Learning and Assessing Science Process Skills,* (3rd Ed.) Dubuque, IA: Kendall/Hunt Publishing Co., pp. 119-132.
- Designing an experimental procedure
  Cothron, J.H., Giese, R.N., & Rezba, R.J. (2000) *Students and Research,* (3rd Ed.) Dubuque, IA: Kendall/Hunt Publishing Co., pp. 37-44.
  Cothron, J. H., Giese, R.N., & Rezba, R.J. (1996). *Science Experiments by the Hundreds,* Dubuque, IA: Kendall/Hunt Publishing Co., pp. 67-76.

- Organizing and analyzing data
  Cothron, J.H., Giese, R.N., & Rezba, R.J. (2000) *Students and Research,* (3rd Ed.) Dubuque, IA: Kendall/Hunt Publishing Co., pp. 45-60, 85-170.
  Cothron, J. H., Giese, R.N., & Rezba, R.J. (1996). *Science Experiments by the Hundreds,* Dubuque, IA: Kendall/Hunt Publishing Co., pp. 83-120.
  Rezba, R.J., Sprague, C., Fiel, R.L., & Funk, H.J., (1995) *Learning and Assessing Science Process Skills,* (3rd Ed.) Dubuque, IA: Kendall/Hunt Publishing Co., pp. 133-172, 193-204.
- Communicating your results
  Cothron, J.H., Giese, R.N., & Rezba, R.J. (2000) *Students and Research,* (3rd Ed.) Dubuque, IA: Kendall/Hunt Publishing Co., pp. 61-70, 267-274.
  Cothron, J. H., Giese, R.N., & Rezba, R.J. (1996). *Science Experiments by the Hundreds,* Dubuque, IA: Kendall/Hunt Publishing Co., pp. 121-140.

- Also consult the website list provided in this packet.
- Use the assessment provided in the appendix (Basic Principles of Experimental Design and Data Analysis: Practice) to determine depth of student understanding.
- Additional teacher resources are provided for management of long-term or short-term (mini) projects.

THE HISTORY AND NATURE OF SCIENCE

Activity 3: Great Scientific Minds
Teacher Notes

The purpose of this activity is to become familiar with scientific research by Nobel Laureates.

Time for lesson: varies (suggest a minimum of 2 class periods)

Materials:
Research tools (computers with internet access, text resources, library access, science magazines and journals)
Scripted question list *(Great Scientific Minds – Interviewing a Nobel Laureate)*
Student generated questions
Access via any communication mechanism to a present day Nobel Laureate (phone, email, face to face, KTLN, snail mail) OR student pair interviews where one student plays the scientist (can be past or present day) and the second is the interviewer
Appropriate technology for student products (video camera, audio tape and player, computer, etc.)

Procedure

- Allow students to visit the Intel website to determine Nobel Laureates who will be visiting ISEF Louisville 2002. (should be posted after March 1 – awaiting final confirmation from participating Laureates – www.intelisef2002.org)

- Ask students to select a Nobel Laureate that may be present at ISEF 2002. (If class is large, teacher may want to allow students to choose any Laureate regardless of presence at ISEF)
- Provide students with research opportunities (a good starting place is www.nobel.se; past and present Laureates have published biographies at this site.)
- Depending on time, a variety of options are present at this point:
  - It may be possible to ask questions of the Laureates at the fair. Continue to check the ISEF website for further information about this possibility.
  - Students can use scripted questions to actually interview a Laureate (if possible) OR role play an interview using the research gathered. Products may be shared in class prior to the ISEF visit for peer evaluation or the teacher may evaluate products independently.
  - Students should generate at least 3 questions to include in the interview.

GREAT SCIENTIFIC MINDS – INTERVIEWING A NOBEL LAUREATE

Ask the following questions as part of your interview of a Nobel Laureate you have researched. (may be asked of the actual scientist or done as a role play)

1. Record the following information about your Laureate.
   Name:
   Country/State of Origin:
   Country/State where research is taking place currently:
   Highest Degree:
   Awarding Institution:

2. Why did you choose science as a career?

3. Discuss your schooling from high school to the present.

4. What math and science courses did you take in high school and college?

5. What math and science courses were of most value to you in your research?

6. What advice would you give to a student interested in your field of study?

7. What challenges did you face in school? In your early career? As you move further into your research?

8. Why do you think you received the Nobel Prize?

9. What are your further plans for research?

10. Ask the Laureate three of your own questions.

THE HISTORY AND NATURE OF SCIENCE: AT THE FAIR

Activity 1: Your International Science Fair Visit
Teacher Notes

The purpose of the lesson is:

1. to examine a single category in depth (Activity 1)
2. to analyze characteristics of an individual investigation for evidence of excellent experimental design (Activity 1)
3. to compare and contrast scientific research techniques, educational background, and interests of student participants and practicing scientists (Activity 2)
4. to communicate information gathered to other students using technology

Time for lesson: day of fair visit

Activity 1: Your International Science Fair Visit

Materials
Student activity sheets
Clipboards/tape recorder
Writing utensils

Procedure

- Pair students and assign each pair a project category for use in the student activities. Allow 45 min. minimum to complete this activity.

- Student pair should complete the worksheet provided. International Science Fair category choices are:
  - Behavioral and Social Sciences
  - Biochemistry
  - Botany
  - Chemistry
  - Computer Science
  - Earth and Space Sciences
  - Engineering
  - Environmental Science
  - Gerontology
  - Mathematics
  - Medicine and Health
  - Microbiology
  - Physics
  - Zoology

    Team projects can be in any discipline and are grouped separately.

- Students will be asked to use the newly released Kentucky Performance Descriptors to recognize the boundary between proficient-like and distinguished-like student products. The exercise is designed to familiarize students with the qualities that proficient/distinguished scientific work should contain.
- Inform the students that in Kentucky classrooms, the performance descriptors will be used to describe COLLECTIONS of student work.

Activity 2: Participant Interview Questions

Materials
Student activity sheets
Clipboards/tape recorder
Writing utensils

Procedure

- Student pair will interview a participant (other than the person whose project they analyzed, preferably an international student) using both scripted and student-generated questions. They will compare the participant responses to the responses from *Great Scientific Minds* (see previsit packet)

Activity 3: Cyberreporting

Materials
Student activity sheet
Appropriate technology

Procedure

- Assign student pair to complete a mini-project from the activity *Cyberreporting at the International Science and Engineering Fair*.
- Depending on available technology, you may wish to have the same student groups already configured from Activity 2 or reassign students in larger groups.
- Feature articles are appropriate transactive writings for the Kentucky Writing Portfolio. You may choose to ask all students to complete this option and assign the other options in other groups. This option may also be customized into other types of writings such as brochures and other authentic writing pieces.

YOUR INTERNATIONAL SCIENCE FAIR VISIT

PROJECT CATEGORIES

1. List seven of the project categories at ISEF.

2. What is your assigned (by your teacher) category?

3. How many projects in your category were done by boys?

4. How many projects in your category were done by girls?

5. As you observe the projects in your category, use the attached United States and World maps to indicate locations where the participants live. Do you notice any trends between geography and specific topics of research? If so, what?

6. Identify a project in your category that requires the integration of science concepts from two or more areas.
   Project Title:
   Brief Description:

8. Identify a project in your category that investigates a science-based societal issue.
   Project Title:
   Brief Description:

9. Identify a project in your category that stands out as exemplary for its use of scientific tools.
   Project Title:
   Brief Description:

EXPERIMENTAL DESIGN

Locate a science project in your category that is of great interest to you or is closely related to your current study of science.

Project Title:

Country or State of Origin:

Answer the following questions about the project you have chosen as you search for evidence of the components of good experimental design.

Purpose of the Project

What was the testable question?

Hypothesis

What is the stated hypothesis?

Procedure

Identify the dependent variable in this investigation.

Identify the independent variable in this investigation.

Data Collection

How many trials were run on this project?

Quantitative Data:

What tools were used on this science project? What type of measurements were collected?

Tool_____Measurement_____Unit_____

Tool_____Measurement_____Unit_____

Tool_____Measurement_____Unit_____

Qualitative Data:

What method of data collection was used?

What type of scale for comparison was used?

How was the data organized prior to analysis?

Data Analysis

Was technology used to analyze data? If so, how?

What types of graphic representations were used in the data analysis?

Was mathematics used to analyze data? If so, how?

Results and Conclusions

How did the student(s) interpret their observations?

Was the hypothesis supported or disputed by the data?

What conclusions were drawn from this experiment?

What further investigations might be conducted?

Analysis of Overall Project

Using the KY Performance Descriptions attached, determine if the project you studied more accurately reflects the Proficient or Distinguished category of performance. Justify your answer.

Your International Science Fair Visit:

Participant Interview Questions

Choose a science fair participant other than the person whose project you previously analyzed. If possible, choose an international student. Ask the following questions.

1. What is your name?

2. What country (state) are you from?

3. How old are you?

4. What level (grade) are you in school?

5. What is the length of your school day?

6. What is the length of your school year?

7. What science and mathematics courses have you taken?

8. About how much time per week do you spend on science related homework?

9. How long have you been working on your project?

10.Did you have a mentor? If so, who was it and how did you connect with him/her?

11. What are your college and career plans?

12. Ask the questions you wrote in the previsit activity *Great Scientific Minds.*

THE HISTORY AND NATURE OF SCIENCE: AFTER THE FAIR

Activity 1: Compare and Contrast Projects Observed to Student Classroom Projects
Teacher Notes

The purpose of the lesson is to look for patterns in quality projects entered in the ISEF and compare them to individual projects already completed by students.

Time for lesson: varies; recommend 1 class period minimum

Materials
Completed activity sheets from ISEF *(Your Visit to the International Science Fair)*
Reports from student projects completed prior to ISEF

Procedure

- Using the questions provided, guide students through an independent analysis of the projects. If possible allow time for classroom discussion after analysis is completed.
- This activity is most beneficial for underclassmen who may be asked to complete projects in future classes.

Activity 2: Reflective Writing

The purpose of the lesson is to ask students to reflect upon their field trip and the educational implications of it.

Time for lesson: varies; may be completed in class or assigned as homework.

Materials
Reflective questions (provided in student packet)

Activity 3: Mapping the Participants

The purpose of the lesson is to ask students to look for patterns in the participant's demographic information from the surveys completed at the fair.

Time for lesson: varies; 1 class period suggested

Materials
Completed activity sheets from ISEF *(Your International Science Fair Visit: Participant Interview Questions)*
Copies of US/world maps provided in packet
Colored pencils/markers
Transparencies made from master maps provided in packet (1 per group)
Copies of student surveys completed at ISEF for each small group

Procedure

- Divide students into small groups. Provide copies of student surveys completed at ISEF for each group and a transparency of the US and world maps for reporting to the class. Assign each group a single aspect of the collected data to map (i.e., geographic representation of participants, gender representation, age of participants represented, subject of research, educational background)
- If several classes collected data, you may wish to compile the results on a single map.

- Ask students to identify possible patterns present in the data collected (i.e., geographic representation of participants/nonparticipants, gender representation, age of participants represented) and to make inferences about the results that are present.
- Optional: compare collected data and maps to the gender and nationality data on the Nobel Laureate web page (www.nobel.se) and discuss any similarities or differences evident.

SUMMARIZING YOUR VISIT TO THE INTERNATIONAL SCIENCE AND ENGINEERING FAIR

Reflect on what you observed at the International Science and Engineering Fair. What was the most meaningful aspect for you in the context of your current science course? What was the most meaningful aspect for you individually? What was the most meaningful aspect for you in looking ahead to your future school and career choices?

COMPARE AND CONTRAST: QUALITIES OF PROJECTS BY OTHER STUDENTS AND QUALITIES OF YOUR OWN PROJECT

Using the worksheet you completed at the International Science and Engineering Fair entitled *Your Visit to the International Science Fair*, answer the following questions. Start with the portion under the subtitle *Experimental Design*.

1. How was the purpose of the project you observed different than the purpose for your project? How was it similar? Use examples.

2. How was the hypothesis of the project you observed different than the hypothesis of your project? How was it similar? Use examples.

3. Compare and contrast the dependent and the independent variables in the project you observed and the project you did. Use examples.

4. Compare and contrast the data collected and how it was presented in the project you observed and the project you did (prior to data analysis). How was it different? How was it similar? Use examples.

5. How was the data analyzed in the project you observed? How did you analyze your data? What differences and similarities did you encounter? Use examples.

6. What results and conclusions were drawn in the project that you observed? What results and conclusions did you draw from your project? What similarities and differences did you encounter? Use examples.

7. What qualities did you observe in the project that you believe are necessary to have in an exemplary project? How many of these qualities may be found in your project?

8. What will you change if you are able to do the experiment in your project again? What will you continue to use again without change if you are able to do the experiment again?

CYBERREPORTING FOR THE INTERNATIONAL SCIENCE AND ENGINEERING FAIR

Using any available technology in your school, complete one of the following mini-projects to report what you encountered at the International Science and Engineering Fair (ISEF) to other students in your school.

- Use a digital camera to document your day at the ISEF. Go to the ISEF website and input information about the competition. Then add text and prepare a photo essay to be posted on your school website.

- Use a regular camera to document your day and prepare a poster display for your school library on the ISEF. Download any appropriate information from the ISEF website that you think students would be interested in to add to your display.

- Video documentation of the fair may not be allowed, so access the ISEF promotional video and include it in a display that other students may view. If it is allowed, video your day and present it to other students. If your school has a news program that a media class produces, include this in that program.

- Using photographs from the fair, write a feature article to be published in your school and/or community newspaper about the fair.

Appendix

The History and Nature of Science

Chapter Correlations

1—Developing Basic Concepts
3—Generating Experimental Topics
17—Scheduling Student Research

TABLE 16.1 Designing and Generating Experiments

1 Evaluating for Success

Name _____ **Period** _____ **Date** _____

Criteria/Value	Self	Peer/ Family	Teacher
Part One—Basic Concepts of Design (100 points)			
Title (5)			
Hypothesis (5)			
Independent variable (10)			
Levels of independent variable (10)			
Control (10)			
Repeated trials (10)			
Dependent variables (10)			
Operational definition of dependent variable (10)			
Constants (15)			
Experimental design diagram (10)			
Creativity/Complexity (5)			
Part Two—Four Question Strategy (100 points)			
Q1: Readily available materials (30) Excellent list Good list Poor list			
Q2: Action of materials (10) Excellent answer (correct) Good answer (partially correct) Poor answer (incorrect)			
Q3: Ways to vary materials (30) Excellent list Good list Poor list			
Q4: Ways to measure actions (20) Excellent list Good list Poor list			
Creativity of prompt (5)			
Creativity of brainstorming (5)			

TABLE 16.3 Constructing Tables and Graphs

3 Evaluating for Success

Name _____ Period _____ Date _____

Criteria/Value	Self	Peer/ Family	Teacher
Part One—Data Tables (100 points)			
Title (10)			
Vertical column for independent variable (10)			
Title/Unit of independent variable included (5)			
Values of independent variable ordered (10)			
Vertical column for dependent variable (10)			
Title/Unit of dependent variable included (5)			
DV column subdivided for repeated trials (10)			
Dependent variables correctly entered (10)			
Vertical column for derived quantity (10)			
Unit of derived quantity included (10)			
Derived quantity correctly calculated (10)			
Part Two—Line Graphs (100 points)			
Title (10)			
X axis correctly labeled including units (10)			
Y axis correctly labeled including units (10)			
X axis correctly subdivided into scale (15)			
Y axis correctly subdivided into scale (15)			
Data pairs correctly plotted (15)			
Data trend summarized with line-of-best-fit (10)			
Data trend summarized with sentences (15)			
Part Three—Bar Graphs (100 points)			
Title (10)			
X axis correctly labeled including units (10)			
Y axis correctly labeled including units (10)			
X axis correctly subdivided—discrete values (15)			
Y axis correctly subdivided into scale (20)			
Vertical bars for data pairs correctly drawn (15)			
Data trend summarized with sentences (20)			

Chapter Correlations
5—Constructing Tables & Graphs
17—Scheduling Student Research

ACTIVITY 17.1 What's Your Interest?

1. Where would you like to work on your project?

   home
   school
   job
   local college or research lab

2. Which type of project interests you?

   practical project
   theoretical project

3. What is your favorite school subject?

   science
   mathematics
   fine arts (art, music)
   humanities (language, social studies, psychology)
   health and physical education
   vocational

4. If science is your favorite area, which science is your favorite?

   biology
   chemistry
   physics
   earth
   environmental

5. If biology is a favorite, which area appeals to you?

   animal behavior
   genetics
   botany
   zoology
   biochemistry
   medical science
   developmental biology

6. What is your favorite hobby?
7. Have you read a journal article or book that appealed to you? What was it about?
8. What are your career interests?

TABLE 16.7 Analyzing and Communicating Data: Descriptive Statistics

Chapter Correlations

8—Analyzing Experimental Data
9—Communicating Descriptive Statistics
10—Displaying Dispersion/ Variation in Data
17—Scheduling Student Research

7 Evaluating for Success

Name _____ Period _____ Date _____

Criteria/Value	Self	Peer/ Family	Teacher
Part 1—Data Tables (100 points)			
Title (5)			
Independent variable/Levels/Units (5)			
Units of dependent variable (5)			
Correct descriptive statistics for data			
Central tendency (10)			
Variation (10)			
Number (5)			
Correct calculations of descriptive statistics			
Central tendency (25)			
Variation (25)			
Number (10)			
Part Two—Graphs (100 points)			
Title (10)			
Correct type of graph for data (15)			
Correct label/Unit/Scale for X axis (25)			
Correct label/Unit/Scale for Y axis (25)			
Data pairs correctly plotted (25)			
Part Three—Paragraphs: Results (100 points)			
Topic sentence (10)			
Comparison of measures of central tendency (25)			
Description of variation (25)			
Support of hypothesis by data (15)			
Sentence/Paragraph structure (10)			
Grammar/Spelling (15)			
Part Four—Conclusion (100 points)			
Purpose of experiment (10)			
Major findings (15)			
Support of hypothesis by data (10)			
Comparison with other research (15)			
Explanations for findings (15)			
Recommendations (10)			
Sentence structure (10)			
Grammar/Spelling (15)			

TABLE 16.8 Analyzing and Communicating Data: Inferential Statistics

8 Evaluating for Success

Name _____ Period _____ Date _____

Criteria/Value	Self	Peer/ Family	Teacher
Part One—Inferential Statistical Test (100 points)			
Correct null hypothesis (10)			
Correct level of significance (5)			
Correct statistical test (10)			
Correct calculations (30)			
Correct degrees of freedom (10)			
Correct table value for statistic (5)			
Correct interpretation of test—significance (10)			
Correct action about null hypothesis (10)			
Correct action about research hypothesis (10)			
Part Two—Data Tables (100 points)			
Title (10)			
Descriptive statistics (40)			
Name of inferential statistical test (10)			
Comparison of calculated/Table values (20)			
Degrees of freedom (10)			
Significance/Probability level (10)			
Part Three—Paragraphs: Results (100 points)			
Topic sentence (10)			
Comparison of descriptive statistics (25)			
Description of statistical test (15)			
Interpretation of statistical test (15)			
Support for research hypothesis (10)			
Writing/Grammar/Spelling (25)			
Part Four—Conclusion (100 points)			
Purpose of experiment (10)			
Major findings, including statistical test (15)			
Support of research hypothesis by data (10)			
Comparison with other research (15)			
Explanations for findings (15)			
Recommendations (10)			
Writing/Grammar/Spelling (25)			

Chapter Correlations

11—Determining Statistical Significance

17—Scheduling Student Research

TABLE 16.6 Collecting Experimental Data

6 Evaluating for Success

Name _____ **Period** _____ **Date** _____

Criteria/Value (100 points)	**Self**	**Peer/ Family**	**Teacher**
Management of time (25)			
All data submitted on time (25)			
Partial data submitted on time (15)			
No data submitted on time/No approved extension (0)			
Adequacy of progress (25)			
Satisfactory progress (25)			
Partially satisfactory progress (15)			
Unsatisfactory progress (0)			
Collection of raw data (50)			
Quantitative data collected (10)			
Raw data table for quantitative data (10)			
Qualitative data/Observations recorded (10)			
Raw data table for qualitative data (10)			
Sufficient measurements/Observations (5)			
Evidence of experiment being conducted (5)			

Revisions & Extensions

Request for Revisions or Deadline Extension *(For additional space, use the back of this sheet.)*

1. What is your project topic?
2. What revisions do you propose? Why are they necessary?
3. What part of your data will be turned in on schedule?
4. When will you turn in the other data?

Teacher Approval _____ **Date** _____

Chapter Correlations

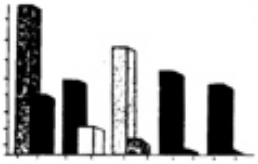
5—Constructing Tables and Graphs
8—Analyzing Experimental Data
17—Scheduling Student Research

TABLE 16.3 Constructing Tables and Graphs

3 Evaluating for Success

Name _____ Period _____ Date _____

Criteria/Value	Self	Peer/ Family	Teacher
Part One—Data Tables (100 points)			
Title (10)			
Vertical column for independent variable (10)			
Title/Unit of independent variable included (5)			
Values of independent variable ordered (10)			
Vertical column for dependent variable (10)			
Title/Unit of dependent variable included (5)			
DV column subdivided for repeated trials (10)			
Dependent variables correctly entered (10)			
Vertical column for derived quantity (10)			
Unit of derived quantity included (10)			
Derived quantity correctly calculated (10)			
Part Two—Line Graphs (100 points)			
Title (10)			
X axis correctly labeled including units (10)			
Y axis correctly labeled including units (10)			
X axis correctly subdivided into scale (15)			
Y axis correctly subdivided into scale (15)			
Data pairs correctly plotted (15)			
Data trend summarized with line-of-best-fit (10)			
Data trend summarized with sentences (15)			
Part Three—Bar Graphs (100 points)			
Title (10)			
X axis correctly labeled including units (10)			
Y axis correctly labeled including units (10)			
X axis correctly subdivided—discrete values (15)			
Y axis correctly subdivided into scale (20)			
Vertical bars for data pairs correctly drawn (15)			
Data trend summarized with sentences (20)			



Chapter Correlations
5—Constructing Tables & Graphs
17—Scheduling Student Research

TABLE 16.2 Describing Experimental Procedures

2 Evaluating for Success

Name _____ **Period** _____ **Date** _____

Criteria/Value (100 points)	**Self**	**Peer/ Family**	**Teacher**
All steps included (30)			
All materials/Equipment included (20)			
Written for one level of independent variable (10)			
Repetitions for repeated trials (10)			
Repetitions for levels of independent variable (10)			
Written in approved format—lists or paragraph (10)			
Spelling/Grammar (5)			
Sentence/Paragraph structure (5)			
Special Comments (See Student Paper)			

Circled items require permission to use living organisms or hazardous chemicals/ procedures.

Starred items (*) may be expensive or difficult to obtain; consider alternative materials, community sources, or grant funds.

Underlined items involve vertebrate experimentation; you will need to obtain a mentor or consider alternatives.

Chapter Correlations

4—Describing Experimental Procedures
14—Encouraging Parental Support
17—Scheduling Student Research

	DISTINGUISHED	PROFICIENT
Content	Student demonstrates *extensive* knowledge of science content as outlined in the core content (i.e., Structure of Atoms; Structure and Properties of Matter; Chemical Reactions; Motions and Forces; Conservation of Energy and Increase in Disorder; Inter-actions of Energy and Matter; Energy in the Earth System; Geochemical Cycles; The Formation and Ongoing Changes of the Earth System; The Formation and Ongoing Changes of the Universe; The Cell; The Behavior of Organisms; The Molecular Basis of Heredity; Biological Change; The Interdependence of Organisms; Matter, Energy, and Organization in Living Systems).	Student demonstrates *appropriate* knowledge of science content as outlined in the core content (i.e., Structure of Atoms; Structure and Properties of Matter; Chemical Reactions; Motions and Forces; Conservation of Energy and Increase in Disorder; Interactions of Energy and Matter; Energy in the Earth System; Geochemical Cycles; The Formation and Ongoing Changes of the Earth System; The Formation and Ongoing Changes of the Universe; The Cell; The Behavior of Organisms; The Molecular Basis of Heredity; Biological Change; The Interdependence of Organisms; Matter, Energy, and Organization in Living Systems).
Process/Inquiry	Student demonstrates *sophisticated* application of appropriate science process/inquiry skills (i.e., refines and refocuses questions, uses appropriate equipment, tools, techniques, technology, and mathematics to gather, analyze, and interpret scientific data, uses evidence to develop scientific explanations, designs and conducts scientific investigations, reviews and analyzes others' investigations, formulates testable hypotheses) to solve problems and /or address issues related to Science and Technology, Science in Personal and Social Perspectives, and History and Nature of Science	Student demonstrates application of appropriate science process/inquiry skills (i.e., refines and refocuses questions, uses appropriate equipment, tools, techniques, technology, and mathematics to gather, analyze, and interpret scientific data, uses evidence to develop scientific explanations, designs and conducts scientific investigations, reviews and analyzes others' investigations, formulates testable hypotheses) to solve problems and /or address issues related to Science and Technology, Science in Personal and Social Perspectives, and History and Nature of Science.
Themes/Concepts	Student demonstrates *extensive* understanding of unifying science themes/concepts (i.e., Patterns, Systems, Scale and Models, Constancy, and Change Over Time).	Student demonstrates *appropriate* understanding of unifying science themes/concepts (i.e., Patterns, Systems, Scale and Models, Constancy, and Change Over Time).
Communication	Student demonstrates *sophisticated* communication skills by organizing information; representing data in several ways (e.g., graphs, drawings, tables, words); communicating (e.g., draw, graph, write) designs, procedures, observations, and results of scientific investigations; using evidence to support conclusions; using appropriate vocabulary; and communicating in a form suited to the purpose and audience.	Student demonstrates *appropriate* communication skills by organizing information; representing data in more than one way (e.g., graphs, drawings, tables, words); communicating designs, procedures, observations, and results of scientific investigations; using evidence to support conclusions; using appropriate vocabulary; and communicating in a form suited to the purpose and audience.
Critical Thinking	Student consistently demonstrates use of critical thinking skills (e.g., evaluates, synthesizes, applies, generalizes, debates).	Student demonstrates *appropriate* use of critical thinking skills (e.g., evaluates, synthesizes, applies, generalizes, debates).

TABLE 17.1 Student Timeline

Assignment	Date Due	Value of Assignment
September		
1. Activity: What's your interest?	September 15	Homework grade
2. Note cards on three popular journal or newspaper articles	September 22	Minor grade *(Rating Sheet 5)*
3. General project topic and action of interest	September 22	Homework grade
4. Note cards on five general sources	September 27	Minor grade *(Rating Sheet 5)*
5. Complete the *Four Question Strategy* for your general project topic	September 29	Minor grade *(Rating Sheet 1, Part II)*
October		
6. Note cards on three scientific articles	October 6	Minor grade *(Rating Sheet 5)*
7. Draft experimental design diagram	October 10	Homework check *(Rating Sheet 1, Part I)*
8. Note cards on five technical manuals and/or community interviews	October 13	Minor grade *(Rating Sheet 5)*
9. Draft list of materials and equipment	October 18	Homework check
10. Parental permission forms for use of live organisms, chemicals, or hazardous procedures	October 23	REQUIRED BEFORE PROCEEDING
11. Draft procedures	October 26	Homework check *(Rating Sheet 2)*
November		
12. Review of the literature	November 9	Major grade *(Rating Sheet 9)*
13. Progress report one or request for revisions/extension	November 16	Homework check *(Rating Sheet 6)*
14. Progress report two or request for revisions/extension	November 30	Homework check *(Rating Sheet 6)*
December		
15. Progress report three or request for revisions/extension	December 8	Homework check *(Rating Sheet 6)*
16. Draft data analysis (tables, graphs, paragraphs)	December 15	Major grade *(Rating Sheet 3 or 7)*
January		
17. Statistical test (if appropriate) and prepare draft table of results and/or paragraph	January 5	Minor grade *(Rating Sheet 8)*
18. Draft conclusion	January 10	Minor grade *(Rating Sheet 7 or 8)*
19. Draft research paper	January 30	Major grade *(Rating Sheet 4 or 9)*
February		
20. Final research paper	February 10	Major grade *(Rating Sheet 4 or 10)*
21. Revise/edit research paper and place in format for competition	Dependent	
March–May		
22. Prepare visual display or oral presentation	March 3	Major grade *(Rating Sheet 11)*
23. Participate in competitive events		
District Science Fair	March 13–16	
Regional Science Fair	April 2–4	
State Academy of Science	May 25–28	
24. Attend Science Night	May 15	

TABLE 17.2 Teaching Timeline

Major Activities	Concepts/Activities Formally Addressed in Class	Student Responsibilities Outside Class
What is a Research Project? (September)		
Designing experiments *(Chapters 1, 2, 12)*	Teach and practice basic concepts of experimental design	Complete homework assignments on scenarios
Parent letter 1: Family involvement in a simple science experiment *(Chapter 14)*	Distribute letter	Deliver letter and invite family
Potential project topics	Motivational presentation on interesting project topics	Complete activity: What's your interest? *(Homework Check)*
Parent letter 2: General overview of research projects and invitation to a meeting *(Chapter 14)*	Distribute letters	Deliver letter and encourage participation
Timeline for completing research project *(Chapter 17)*	Distribute timeline	Follow timeline
Establish student folders *(Chapter 17)*	Expectations for students' project folders	Maintain project folders
Parent meeting	Remind students	Attend meeting and bring parents
What is My Project? (September–October)		
Library skills: Establish an interest—topic connection *(Chapter 7)*	Discuss popular journals and newspapers: teach skills of referencing and taking notes	Complete note cards on popular journal or newspaper articles *(Rating Sheet 5—minor grade)*
Student/parent letter 6: Insufficient progress on project topic *(Chapter 14)*	Distribute letters to appropriate students/parents	Deliver letter to parents make appointment with teacher
Generating ideas for project *(Chapter 3)*	Teach the *Four Question Strategy* Practice the *Four Question Strategy* using a variety of props	Complete assignments on the Four Question Strategy *(Rating Sheet 1, Part II—homework check)*
Parent letter 8: Library research *(Chapter 14)*	Distribute letters	Deliver letter
Library skills: Use general references to narrow topic *(Chapter 7)*	Teach library classification systems, card catalog, references, scanning, note-taking	Complete note cards on general sources *(Rating Sheet 5—minor grade)* Complete Four Question Strategy for project topic *(Rating Sheet 1, Part II—minor grade)*
Library skills: Use of scientific journals to clarify variables *(Chapter 7)*	Teach use of scientific indices, referencing, scanning, note-taking	Complete note cards on scientific articles *(Rating Sheet 5—minor grade)* Complete draft experimental design diagram for project *(Rating Sheet 1, Part I—homework check)*
Writing procedures *(Chapter 4)*	Teach and practice writing procedures	Complete assignments on procedures *(Rating Sheet 2—homework check)*

(continued on the following page)

TABLE 17.2 (continued)

Major Activities	Concepts/Activities Formally Addressed in Class	Student Responsibilities Outside Class
How Do I Write About Scientific Research? (January–February)		
Research paper *(Chapter 13)*	Review components of research paper and criteria for evaluation	Complete draft research paper *(Rating Sheet 4—major grade)*
Parent letter 9: Review of draft research paper *(Chapter 14)*	Distribute letters	Deliver letter
		Prepare final research paper *(Rating Sheet 4 or 10—major grade)*
Parent letters 10–11: Participation in competitive events *(Chapter 14)*	Distribute letters (if appropriate)	Deliver letter (if appropriate)
Preparing written papers for competition *(Chapter 13)*	Revise competitive requirements, distribute forms, and so on	Revise/edit research papers and place in appropriate format for submitting for competition
How Do I Present Research? (March–May)		
Preparing oral and visual displays of projects *(Chapter 18)*	Discuss components of good oral and visual displays and tips for preparing	Prepare oral or visual displays of project *(Rating Sheet 11—major grade)*
Assisting students involved in competition *(Chapter 18)*		Fulfill requirements and meet with teacher at appointed time
Publicity on students involved in competition		
Parent letter 12: Requirements for upcoming competitive events *(Chapter 14)*	Distribute letters	Deliver letter and obtain permission to participate
Competitive events *(Chapters 18, 19)*		Student participation in events
I Did It! (May–June)		
Parent letter 13: Letter of appreciation and invitation to attend science night *(Chapter 14)*	Distribute letters	Deliver letter and encourage parents to attend
Science night: Showcase achievements of *all* students		Attend science night with parents

TABLE 17.3 Miniproject Schedule

Major Concepts	Classroom Activities (Group or Individual Work)
What Is a Resource Project?	
Developing basic concepts *(Chapters 1, 2)*	Teach & practice basic concepts of experimental design *(Rating Sheet 1, Part I)*
What Is My Project?	
Generating ideas for projects *(Chapter 3)*	• Teach & practice the *Four Question Strategy* • Generate ideas for investigations using designated prompts • Group decision on potential topic to investigate
Using library references to narrow topic *(Chapter 7)*	• Teach & practice appropriate library skills to students using textbooks & school library materials • Group completes note cards *(Rating Sheet 5)*
Writing an introduction *(Chapter 6 or 13)*	• Teach & practice writing an introduction for a simple report *or* scientific research paper • Group prepares introduction for an investigation
Preparing experimental design *(Chapters 1, 2, or 12)*	• Group prepares experimental design diagram *(Rating Sheet 1, Part I)*
Writing procedures *(Chapter 4)*	• Teach & practice writing procedures • Group prepares procedures for investigation *(Rating Sheet 2)*
How Do I Collect and Analyze Data?	
Constructing data tables *(Chapter 5)*	• Teach how to make a simple data table • Group prepares data table for investigation
Conducting an investigation	• Group conducts investigation & records data *(Rating Sheet 3, Part I)*
Analyzing data & writing results *(Chapters 5, 6 or 8, 9, 10, 11)*	• Teach appropriate data analysis and writing skills for students—simple data tables/graphs, descriptive statistics, inferential statistics • Group prepares data analysis for investigation—tables, graphs, paragraphs *(Rating Sheet 3, 7 or 8)*
How Do I Write About Scientific Research?	
Write a conclusion *(Chapters 6 or 9, 10, 11, 12, 13)*	• Teach how to write a conclusion • Group prepares conclusion *(Rating Sheet 3, 7, or 8)*
Reporting scientific research *(Chapter 6 or 13)*	• Teach appropriate type of report for students—simple report or scientific research paper • Group prepares written report *(Rating Sheet 4 or 10)*
How Do I Present Research?	
Presenting scientific research *(Chapter 18)*	• Teach how to make an oral or visual presentation • Group prepares presentation *(Rating Sheet 11)* • Group presents scientific research
I Did It!	

Practice

For each of the scenarios below answer questions A–D.

A. Identify the independent variable, levels of the independent variable, dependent variable, number of repeated trials, constants, and control (if present).
B. Identify the hypothesis for the experiment. If the hypothesis is not explicitly stated, write one for the scenario.
C. Draw an experimental design diagram, which includes an appropriate title and hypothesis.
D. State at least two ways to improve the experiment described in the scenario.

1. Ten seeds were planted in each of 5 pots found around the house that contained 500 g of "Pete's Potting Soil." The pots were given the following amounts of distilled water each day for 40 days: Pot 1, 50 ml; Pot 2, 100 ml; Pot 3, 150 ml; Pot 4, 200 ml; Pot 5, 250 ml. Because Pot 3 received the recommended amount of water, it was used as a control. The height of each plant was measured at the end of the experiment.
2. Gloria wanted to find out if the color of food would affect whether kindergarten children would select it for lunch. She put food coloring into 4 identical bowls of mashed potatoes. The colors were red, green, yellow and blue. Each child chose a scoop of potatoes of the color of their choice. Gloria did this experiment using 100 students. She recorded the number of students that chose each color.
3. Susie wondered if the height of a hole punched in the side of a quart-size milk carton would affect how far from the container a liquid would spurt when the carton was full of the liquid. She used 4 identical cartons and punched the same size hole in each. The hole was placed at a different height on one side of each of the containers. The height of the holes varied in increments of 5 cm, ranging from 5 cm to 20 cm from the base of the carton. She put her finger over the holes and filled the cartons to a height of 25 cm with a liquid. When each carton was filled to the proper level, she placed it in the sink and removed her finger. Susie measured how far away from the carton's base the liquid had squirted when it hit the bottom of the sink.
4. Sandy heard that plants compete for space. She decided to test this idea. She bought a mixture of flower seeds and some potting soil. Into each of 5 plastic cups she put the same amount of soil. In the first cup she planted 2 seeds, in the second cup she planted 4 seeds, in the third cup 8 seeds, and in the fourth cup she planted 16 seeds. In the last cup she planted 32 seeds. After 25 days, she determined which set of plants looked best.
5. Esther became interested in insulation while her parent's new house was being built. She decided to determine which insulation transferred the least heat. She filled each of 5 jars half-full with water. She sealed each jar with a plastic lid. Then she wrapped each jar with a different kind of insulation. She put the jars outside in the direct sunlight. Later, she measured the temperature of the water in each jar.

TABLE 16.11 Presenting Scientific Research

11 Evaluating for Success

Name _____ Period _____ Date _____

Criteria/Value	Self	Peer/ Family	Teacher
Content (50)			
Background information (10)			
Statement of problem (5)			
Methods and materials (5)			
Results (15)			
Discussion-conclusion (15)			
Questioning (20)			
Knowledge of topic (5)			
Recognition of limitations (5)			
Recommendations for further study (5)			
Acknowledgments (5)			
Presentation of research—use appropriate criteria for presentation.			
Visual display (30)			
Size requirements (6)			
Accurate (6)			
Legible (6)			
Quality photographs/Drawings and so on (6)			
Attractive (6)			
Oral Presentation (30)			
Delivery (15)			
Eye contact (5)			
Volume (5)			
Pace (5)			
Audiovisual Materials (15)			
Relevant to presentation (5)			
Legible/attractive (5)			
Quality slides/transparencies (5)			

Chapter Correlations

17—Scheduling Student Research
18—Presenting Student Research
19—Preparing to Judge Competitions

Regional Science Fairs in Kentucky

Louisville Regional Science Fair – Life Science
Louisville Regional Science Fair – Physical Science
Director: Thomas H. Crawford, Dept. of Chemistry, University of Louisville, Louisville, KY 40292
502-852-5972
thcraw01@athena.louisville.edu

du Pont Manual High School Regional Biological Science Fair
du Pont Manual High School Regional Physical Science Fair
Director: Glen (Skip) Zwanzig, du Pont Manual High School, 120 W. Lee Street, Louisville, KY 40208
502-485-8241
szwanzig@iglou.com

North & Central Kentucky Exposition of Science – Life Science
North & Central Kentucky Exposition of Science – Physical Science
Contact Person: Karen Ware, NS448 Northern Kentucky University, Highland Heights, KY 41099
859-572-6571

Southern Kentucky Regional Science Fair
Director: Linda Walker, Warren Central High School, 559 Morgantown Road, Bowling Green, KY 42101
270-842-7302

Owensboro-Western Kentucky Science Fair
Director: Mary Thomaskutty, 768 Alexandria Place, Owensboro, KY 42302
270-686-1110 (Owensboro High School) or
270-684-5657 (home)
mthomaskutty@owensboro.K12.KY.US

Purchase Area Regional Science Fair
Director: William Murphy, University of Kentucky Extended Campus, PO Box 7380, Paducah, KY 42002-7380
270-534-6341
wmurphy@engr.uky.edu

Science Fair Sites:

http://www.sciserv.org/isef/
http://www.usc.edu/CSSF/Resources/Good_Project.html
http://www.nsta.org/297
http://users.massed.net/~tedrowan/primer.html
http://www.sciencepage.org/scifair.htm
http://www.cln.org/themes/science_fair.html
http://www.funsci.com/fun3_en/fair/fair.htm
http://www.usc.edu/CSSF/Resources/GettingStarted.html
http://www.madsci.org/libs/areas/sci_fair.html
http://www.scifair.org/
http://www.ipl.org/youth/projectguide/
http://www.ipl.org/youth/projectguide/
http://physics.usc.edu/~gould/ScienceFairs/
http://othello.mech.nwu.edu/~peshkin/scifair/chiparent.html
http://www.hpl.lib.tx.us/youth/science_fair_index.html
http://www.infotoday.com/MMSchools/NovMMS/cyberbee11.html
http://othello.mech.nwu.edu/~peshkin/scifair/
http://www.cs.uh.edu/~clifton/science-fair.micro.html
http://www.chipublib.org/008subject/009scitech/scifair.html
http://www.nearctica.com/educate/scifair.html
http://www.ericse.org/digests/dse98-1.html
http://www.pen.k12.va.us/Anthology/Pav/Va_Assoc_Sci/scifa.html
http://www.just-for-kids.com/EDUSFR.HTM
http://directory.google.com/Top/Science/Educational_Resources/Science_Fairs/Ideas_and_Guides/
http://www.iit.edu/~smile/sfintros.html
http://cybersleuth-kids.com/sleuth/Science/Science_Fair/Virtual_Science_Fairs/
http://www.middleweb.com/CurrScienceFair.html
http://www.middleweb.com/CurrScienceFair.html
http://www.internet4classrooms.com/sciencefair.htm
http://elementarypgms.brevard.k12.fl.us/science_fairs.htm
http://www.ualberta.ca/OUTREACH/Science%20Fair.html

http://www.tufts.edu/as/wright_center/	(Science Olympiad)
http://www.science-education.org/	(Project Learning Tree)
http://www.explorescience.com/	(Space Science Activities and others)
http://www.explorescience.com/	(NASA Space Science Activities)
http://ese.ssl.berkeley.edu/	(Berkley Space Science Activities)
http://www.aristotle.net/~asta/links.htm	(A variety of science education sites)

Related Web Sites

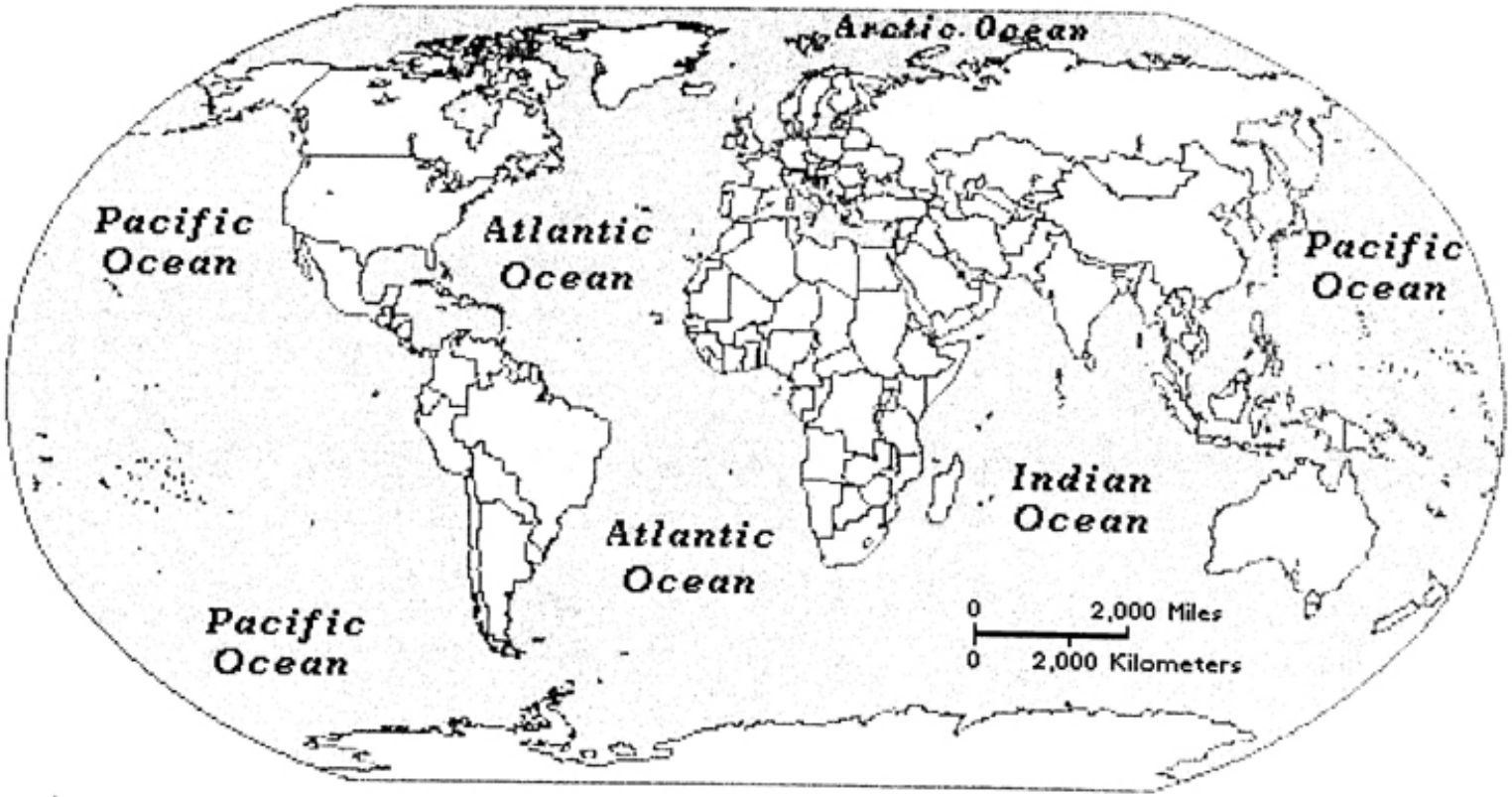
http://pointer.wphs.K12.va.us/118sci.htm (elementary)
http://sln.fi.edu/tfi/activity/act-summ.html
http;//www.ars.usda.gov/is/kids/fair/ideas.htm
http://members.aol.com/ScienzFairs/ideas.htm
http://www.pdlab.com/experiment.htm (Teacher background; written from business perspective.)
http://www.isd77.K12.mn.us/resources/cf/SciProjIntro.html (Elementary Grade Level)
http://ibms50.scri.fsu.edu/~dennisl/CMS.html (Middle School Level)
http://www.ed.gov/pubs/parents/Science
http://www.mcrel.org/resources/links/index.asp
http://www.awesomelibrary.org/science.html
http://nyelabs.kcts.org/flash_go.html
http://www.scri.fsu.edu/~dennisl/CMS/special/sf-hints.html (basic hints)
http://134.121.112.29/sciforum/guiding.html (Questions as prompts)
http://www.isd77.k12.mn.us/resources/cf/SciProjInter.html (general discussion of experimenting)
http://www.eduzone.com/Tips/science/SHOWTIP2.HTM
http://www.stemnet.nf.ca/~jbarron/scifair.html
http://www.sci.mus.mn.us/sln/tf/nav/thinkingfountain.html
http://www.exploratorium.edu/learning_studio/index.html
http://kidscience.miningco.com
http://www.waterw.com/~science/sample.html (Middle School)
http://weber.u.washington.edu/~chudler/experi.html (Human Biology)
http://www.flash.net/~spartech/ReekoScience/ReekoIndex.htm
http://ericir.syr.edu/Projects/Newton
http://www.eecs.umich.edu/mathscience/funexperiments/agesubject/age.html
http://www.eskimo.com/~billb/amasci.html
http://youth.net/nsrc/sci/sci.001.html
http://www.ksw.org.uk/physics/1_curric/curric.html

TABLE 17.2 (continued)

Major Activities	Concepts/Activities Formally Addressed in Class	Student Responsibilities Outside Class
Library skills: Consult technical handbooks, manuals, and community agencies to refine procedures *(Chapter 7)*	Discuss technical manuals, handbooks, and community agencies; teach interviewing skills	Complete note cards on technical materials and community interviews *(Rating Sheet 5—minor grade)*
Review of materials and equipment list *(Chapter 4)*	Discuss safety considerations, humane treatment of organisms, funding, community resources	Submit draft list of materials and equipment for project *(homework check)*
Parent letters 3–5: Permission for use of organisms, chemicals, hazardous procedures *(Chapter 14)*	Distribute letters to appropriate students	Deliver letter and return signed permission; complete draft procedures for project *(Rating Sheet 2—homework check)*
Write review of literature *(Chapter 13)*	Provide structured outlines/questions for students to use in reviewing adequacy of library research; teach requirements for introduction	Conduct additional library research as needed Write review of the literature *(Rating Sheet 9—major grade)*
How Do I Collect and Analyze Data? (November–January)		
Conduct research		Submit progress report one or request for deadline extensions *(Rating Sheet 6—homework check)* Submit progress report two or request for revisions and deadline extensions *(Rating Sheet 6—homework check)*
Student/parent letter 7: Insufficient progress on research *(Chapter 14)*	Distribute letters to appropriate students/parents	Deliver letter to parents Make appointment with teacher Submit progress report three or request for revisions and deadline extensions *(Rating Sheet 6—homework check)*
Non-inferential statistical techniques for analyzing data and writing results *(Chapters 6, 8, 9, 10)*	Teach appropriate data analysis and writing skills to your students • Simple data table and graphs • Quantitative and qualitative data tables	Complete homework assignments on analyzing data and writing results Prepare draft data analysis: Tables, graphs, paragraphs *(Rating Sheets 3 or 7—major grade)*
Inferential statistical techniques for analyzing data *(Chapter 11)*	Teach statistical tests • *t* test • chi-square	Complete homework assignments on statistical tests Conduct statistical tests (if appropriate) and prepare draft tables of results and/or paragraphs *(Rating Sheet 8—minor grade)*
Writing a conclusion *(Chapters 6, 9)*	Teach how to write a conclusion	Complete draft conclusion for project *(Rating Sheet 7 or 8—minor grade)*

(continued on the following page)

The World



World map created using
Mapmaker's Toolkit
Tom Snyder Productions -
Printed with permission
12-11-01

UNITED STATES (Including Alaska and Hawaii)

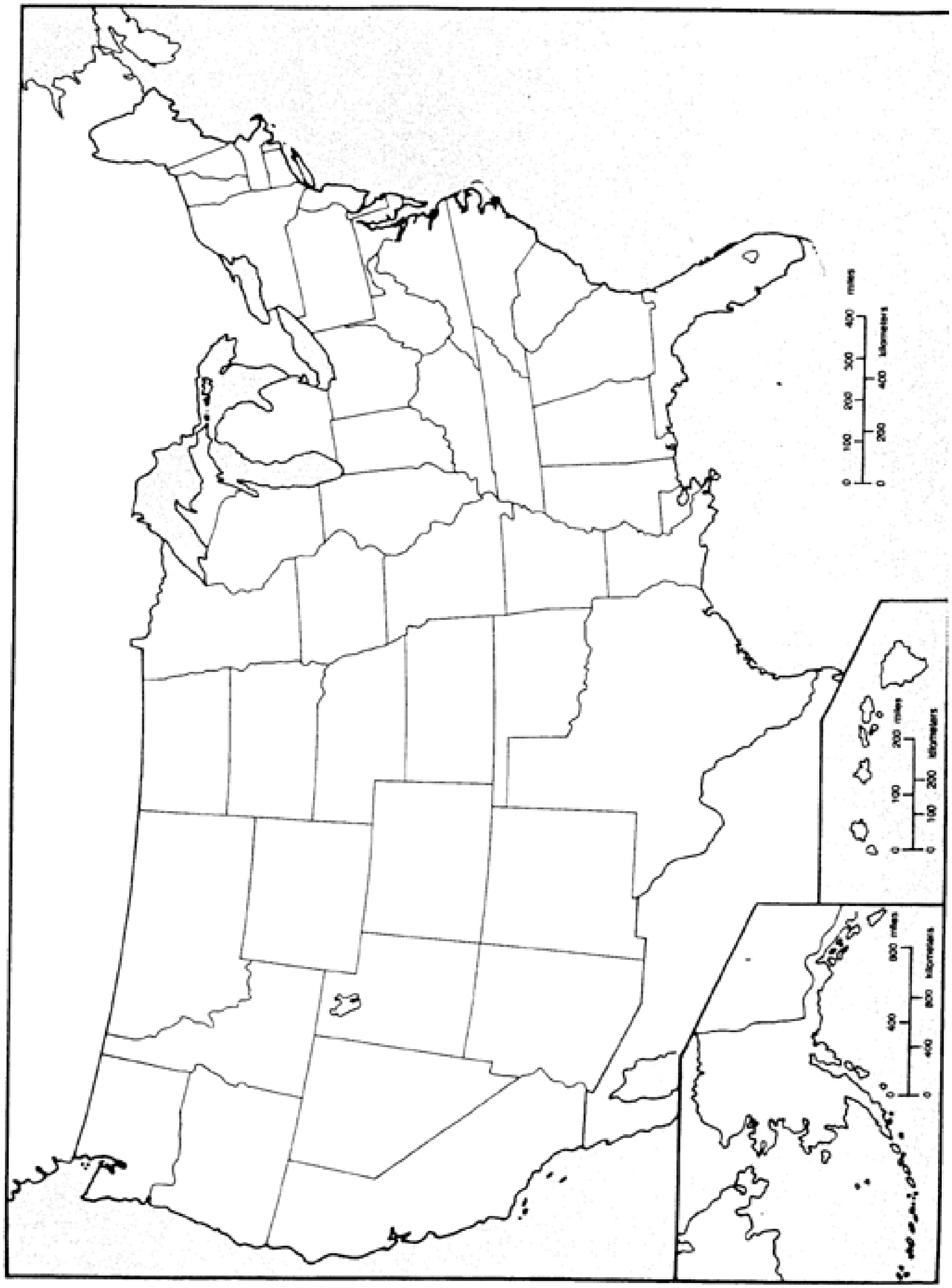


TABLE 16.5 Using Library Resources

5 Evaluating for Success

Name _____ Period _____ Date _____

Criteria/Value		Self	Peer/ Family	Teacher
Proper Identification of Sources (15)				
Call number/Phone number (2)				
Location/Address (3)				
Correctly documented source (10)				
Note-taking skills (25)				
Accurate information (5)				
Paraphrased words and phrases (10)				
Quotations around authors' words (5)				
Page numbers noted (5)				
Organizational skills (10)				
Required number of sources submitted (5)				
Legible writing (2)				
Cards organized by source and numbered (3)				
Required information (50)—Use appropriate criteria for assignment.				
General source	Topic sentence (10)			
	Major points (30)			
	Additional references (10)			
Scientific research	Purpose/Hypothesis (5)			
	Experimental design (10)			
	Procedure (5)			
	Major findings/Conclusion (15)			
	Areas for further research (10)			
	Additional references (5)			
Technical procedures	Name of procedure (5)			
	Materials/Equipment/ Availability (15)			
	Brief synopsis of steps (15)			
	Ability to execute (10)			
	Additional references (5)			
Interview	Questions for interview (15)			
	Responses to questions (15)			
	Reviewing/Editing of notes (10)			
	Letters of appreciation (10)			

Chapter Correlations
7—Using Library Resources
17—Scheduling Student Research

TABLE 16.4 Writing a Simple Report

4 Evaluating for Success

Name _____ Period _____ Date _____

Criteria/Value	Self	Peer/ Family	Teacher
Title/Introduction (16)			
Correct title (4)			
Rationale (4)			
Purpose (4)			
Hypothesis (4)			
Experimental design (16)			
Name/Levels/Units of independent variable (4)			
Control (4)			
Repeated trials (4)			
Name/Units of dependent variable (4)			
Procedures (12)			
All steps, equipment, and materials included (4)			
Written for one level of independent variable (2)			
Repetitions for repeated trials and levels of IV (2)			
Spelling/Grammar (4)			
Results—data tables (16)			
Labeled vertical column for independent variable (4)			
Labeled vertical column for dependent variable (4)			
Labeled vertical column for derived quantity (4)			
Correct values of IV, DV, derived quantity (4)			
Results—graphs (16)			
Correct label/Unit/Scale for X axis (4)			
Correct label/Unit/Scale for Y axis (4)			
Data pairs correctly plotted (4)			
Data trends summarized (4)			
Conclusion (24)			
Purpose of experiment (2)			
Major findings (4)			
Support of hypothesis by data (4)			
Comparisons/Explanations (4)			
Recommendations—Further Study/Improvement (4)			
Spelling/Grammar (6)			

Chapter Correlations
6—Writing a Simple Report
17—Scheduling Student Research

TABLE 16.9 Writing a Review of the Literature

9 Evaluating for Success

Name _____ Period _____ Date _____

Criteria/Value	Self	Peer/ Family	Teacher
General background information (30–60)			
Independent variable (15–30)			
Dependent variable (15–30)			
Prior research—optional (0–30)			
Description of prior research (10)			
Analysis of prior research (10)			
Questions for future study (10)			
Statement of problem (15)			
Rationale (5)			
Purpose (5)			
Research hypothesis (5)			
Writing (15)			
Logical organization/Effective transitions (5)			
Sentence/Paragraph structure (5)			
Grammar/Spelling (5)			
General format (10)			
Title page (2)			
Bibliography (4)			
Footnotes (2)			
Other requirements (2)			

Comments

Comments: You need to add additional information in the areas that are circled.

Animal/Plant/Protist
Name/Classification
Anatomy
Physiology
Life Cycle
Behavior/Response
Comparisons
Predictions

Behavior
Type
Factors influencing
Value
Methods describing
Sample selection
Comparisons
Predictions

Matter
Names
Formula
Physical properties
Chemical properties
Methods of production
Uses
Comparisons
Predictions

Energy
Form
Production
Measurement
Transformed
Interaction with matter
Examples
Comparisons
Predictions

Process/Procedure
Purpose
Major steps
Occurrence
Relationship to experiment
Comparisons
Predictions

Chapter Correlations
13—Writing Formal Papers
17—Scheduling Student Research

Chapter Correlations

13—Writing Formal Papers

17—Scheduling Student Research

TABLE 16.10 Writing a Scientific Research Paper

10 Evaluating for Success

Name _____ Period _____ Date _____

Criteria/Value (100 points)	Self	Peer/ Family	Teacher
Introduction (15)			
Background on IV and DV (5)			
Review of prior research (5)			
Statement of problem (5)			
Methods and Materials (10)			
All materials/Equipment included (5)			
Clear/Precise description (5)			
Results (20)			
Data tables (5)			
Graphs (5)			
Paragraphs of results (5–10)			
Statistical Test—optional (0–5)			
Discussion and Conclusion (20)			
Purpose of experiment (3)			
Major findings (5)			
Support of research hypothesis by data (3)			
Comparison with other research (3)			
Explanations for findings (3)			
Recommendations (3)			
Writing (20)			
Logical organization/Effective transitions (5)			
Sentence/Paragraph structure (5)			
Grammar/Spelling (10)			
General Format (15)			
Abstract (5)			
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